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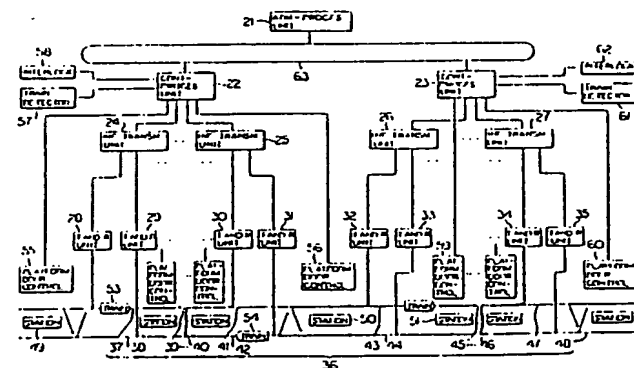
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㉗ Method and apparatus for administration and control of train service.

㉘ Transmitter and receiver units (28, ..., 31, 32 ..., 35) each connected to corresponding one of a plurality of sections (37, ..., 42; 43 ..., 48) of an information transmission line (36), information transmission units (24, 25; 26, 27), control-processing unit (22; 23) and a single administration-processing unit (21) are arranged to form a hierarchy structure. The administration-processing unit (21) monitors the operation of the whole system and supplies to the control-processing units (22; 23) information relating to a train service schedule of a group of trains, a modified train service schedule to meet a change in demand, etc., and the control-processing units (22; 23) performs the traffic control of each train.



EP 0 108 363 A3

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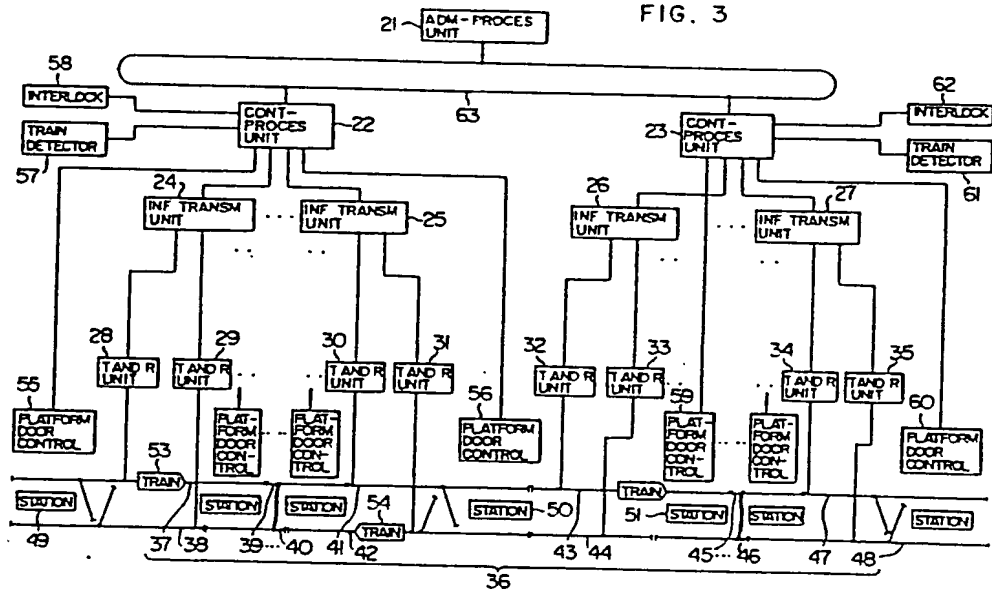
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FIG. 3



METHOD AND APPARATUS FOR
ADMINISTRATION AND CONTROL OF TRAIN SERVICE

1 This invention relates to a method and apparatus
for administration and control of train service.

 Prior art train service administration and control
systems which can attain unmanned train operation are
5 broadly classified into a so-called centralized control
type and a so-called decentralized control type. The
prior art system of the centralized control type is
shown in FIG. 1. Referring to FIG. 1, an information
transmission line 6 extending along the entire length
10 of the track (not shown) laid for running of trains 7A
to 7X (of which only two, 7A and 7X, are shown) is divided
into a plurality of sections 6A, 6B, 6C, 6D, ..., 6K,
6L, 6M and 6N (some of which are not shown). Transmitter
and receiver units 5A, 5B, ..., 5M and 5N are respectively
15 connected to the individual sections 6A, 6B, ..., 6M
and 6N of the information transmission line 6. (The
transmitter and receiver units 5C to 5L corresponding to
the sections 6C to 6L respectively are not shown to
avoid confusion of illustration.) A single or a plu-
20 rality of information transmission units 4 are connected
to all of the transmitter and receiver units 5A, 5B,
..., 5M and 5N to transmit and receive information
required for the control of the operation of the trains
7A to 7X existing within the extent of the sections 6A
25 to 6N of the information transmission line 6. (In FIG. 1,

1 a single information transmission unit 4 is shown.)

Connected to the information transmission unit 4 is a train service administration and control unit 1 to exchanging information with the information trans-

5 mission unit 4. Connected to the train service administration and control unit 1 are platform door control units 10A to 10Z controlling opening and closure of doors disposed at the platform of stations 8A to 8Z.

Connected also to the train service administration

10 and control unit 1 are a train detection unit 11 and an interlocking operation unit 12. Both of the train service administration and control unit 1 and the information transmission unit 4 are collectively installed in a central control center. The train service

15 administration and control unit 1 functions to prepare the train service schedule, administrate the group of the trains and control the operation of the individual trains.

According to such a train service administration and control system of the centralized control type, the
20 structure of its control system can be simplified, and all of necessary information can be collected in the train service administration and control unit 1. Therefore, this sytem has such an advantage that the operators can acquire all the information of the whole system and
25 can readily intervene or interrupt in the control as required. This sytem has such another advantage that the installation of the important parts of the system in the central control center facilitates maintenance of those

1 parts. However, the prior art system of the centralized
control type has such a disadvantage that, in the event
of occurrence of an accident, the load attributable to
the accident is added to the normal load of the train
5 service administration and control unit 1, and the response
speed for processing is inevitably reduced due to the
concentration of the loads to be processed. Further, the
prior art system of the centralized control type has
such another disadvantage that the expansion of the system
10 to deal with an extension of the train track is difficult
since the load to be processed by the unit 1 is generally
proportional to the length of the track or the frequency
of train service.

The prior art train service administration and
15 control system of the decentralized control type is shown
in FIG. 2. In FIG. 2, the same reference numerals are
used to designate the same or equivalent parts appearing
in FIG. 1. In the system of the distributed control
type, station control units 9A to 9Z are disposed for the
20 individual stations 8A to 8Z respectively. All of these
station control units 9A to 9Z are connected to the
train service administration and control unit 1. Con-
nected to the station control units 9A to 9Z are the plat-
form door control units 10A to 10Z, interlocking operation
25 units 12A to 12Z and station information transmission
lines 13A to 13Z respectively. Information of a train or
trains stopped at the station or stations and information
of the individual stations are exchanged between the train

1 service administration and control unit 1 and the station
control units 9A to 9Z. The train service administration
and control 1 monitors generally the status of the indi-
vidual trains 7A to 7X and applies to the station control
5 units 9A to 9Z, the train control information for control-
ling the trains according to a predetermined schedule of
train service. The station control units 9A to 9Z control
the operation of the trains 7A to 7X according to a
predetermined sequence and timing. While the trains 7A
10 to 7X are running, the train service administration and
control unit 1 monitors the status of the trains on the
basis of information applied through the information
transmission unit 4 and transmits the control command
through the information transmission unit 4.

15 The system of the decentralized control type has
such an advantage that the load processed by the train
service administration and control 1 can be distributed
to improve the response speed for processing. However,
due to the fact that the component units of the system
20 are widely distributed, the maintenance of the distri-
buted units is not easy, and the necessity for providing
two systems of the train information transmission line 6
and station information transmission lines 13, leads to
an increase in the cost. Further, when any one of the
25 station control units 9A to 9Z is disabled, the function
of the disabled one of the station control units 9A to
9Z cannot be substituted by the train service administra-
tion and control unit 1 disposed in the central control

1 center and since the trouble cannot be dealt with by
intervention from the central control center, an operator
must be dispatched to the associated stations 8A to 8Z
for which the station control units 9A to 9Z are provided
5 respectively. The prior art system of the distributed
control type is therefore defective in that the unmanning
of the stations cannot be realized in such an event.

With a view to solve the technical problems encountered by the prior art systems described above, it is
10 a primary object of the present invention to provide a
method and apparatus for administration and control of
train service, which increases the response speed for
processing, facilitates an expansion of the system to deal
with an extension of the train track and yet permits easy
15 maintenance of the system.

The present invention provides a method and
apparatus for train service administration and control
including means for exchanging information including
status information indicative of the operating status of
20 each of a plurality of trains running on the track and
command information controlling the operation of the
train, through an information transmission line divided
into a plurality of sections of a predetermined length
extending along the entire length of the track thereby
25 controlling the train operation according to a train
service schedule, the apparatus comprising a plurality
of transmitter and receiver units connected individually
to the sections of the information transmission line,

1 at least one information transmission unit installed in
a central control center to be connected to at least one
of the transmitter and receiver units, at least one control-
processing unit installed in the central control center
5 to be connected to the information transmission unit,
and a single administration and control unit installed
in the central control center to be connected to the
control-processing unit, all of the units being disposed
in a hierarchy in the above order, so that the distribu-
10 tion of processing functions to the administration-
processing unit and control-processing unit can improve
the response speed of these processing units.

The present invention differs from the prior art
system of the centralized control type in that the train
15 service administration-processing unit is divided into a
single administration-processing unit and a plurality of
control-processing units constituting a hierarchy
structure, and the tasks of the processing for administ-
ration and the processing for control are respectively
20 allocated to respective stages of the hierarchy thereby
improving the response speed for processing. The present
invention differs also from the prior art system of the
distributed control type in that all of information are
collected in a central control center for conveniences
25 of the operators, and simplification of the structure of
the system and improvement in the maintenance are
further achieved.

Preferred embodiments of the present invention

1 will now be described in detail with reference to the drawings.

FIGs. 1 and 2 are block diagrams illustrating the prior art train service administration and control
5 systems.

FIG. 3 is a block diagram of a preferred embodiment of the present invention.

FIG. 4 is a block diagram showing the detailed structure of the control-processing unit 22 shown in
10 FIG. 3.

FIG. 5 is a block diagram of another preferred embodiment of the present invention.

Referring to FIG. 3 which is a block diagram of a preferred embodiment of the present invention, the
15 train service administration and control system according to the present invention comprises an administration-processing unit 21, a plurality of or, for example, two control-processing units 22 and 23, a plurality of information transmission units 24, ..., 25 and 26, ..., 27
20 (some of which are not shown), and a plurality of transmitter and receiver units 28, 29, ..., 30, 31, 32, 33, ..., 34 and 35 (some of which are not shown). The administration-processing unit 21 and the control-processing units 22, 23; the control-processing units
25 22, 23 and the information transmission units 24 to 27; and the information transmission units 24 to 27 and the transmitter and receiver units 28 to 35 are disposed in a hierarchy as shown.

1 An information transmission line 36 extends
along the entire length of the track laid for running of
trains (of which only two, 53 and 54, are shown). This
information transmission line 36 is divided into a plu-
5 rality of sections 37, 38, 39, ..., 40, 41, 42, 43, 44,
45, ..., 46, 47 and 48 (some of which are not shown in
FIG. 3). The sections 37 to 42 of the information
transmission line 36 are those disposed along a section
of track which was constructed in the first stage of the
10 tranck construction work, while the sections 43 to 48 of
the information transmission line 36 are those disposed
along an extended track section which was constructed
in the second stage of the track construction work carried
out to extend the track. Stations 49, ..., 50 are those
15 provided in the first stage of the track construction
work, while stations 51, ..., 52 are those provided in
the second stage of the track construction work. The
transmitter and receiver units 28 to 35 are disposed in
a relation individually corresponding to the sections 37
20 to 48 respectively of the information transmission line
36. (The transmitter and receiver units corresponding
to the sections 39, ..., 40 and 45, ..., 46 of the
information transmission line 36 are not shown.) These
transmitter and receiver units 28 to 35 are installed in
25 the individual stations nearest thereto or two or more
of them are collectively installed in each of the key
stations of a plurality of stations.

The transmitter and receiver units 28 to 35

1 are divided into a plurality of groups (some of which
are not shown), and the information transmission units 24
to 27 are disposed in a relation corresponding individually
to the groups of the transmitter and receiver units 28
5 to 35. In FIG. 3, the transmitter and receiver units
28 and 29 are connected to the information transmission
unit 24, and the transmitter and receiver units 30 and 31
are connected to the information transmission unit 25.
The transmitter and receiver units 32 and 33 are connected
10 to the information transmission unit 26, and the transmit-
ter and receiver units 34 and 35 are connected to the
information transmission unit 27.

The information transmission units 24 to 27 are
divided into a plurality of groups, for example, two
15 groups as shown, and the control-processing units 22 and
23, which may be composed of computers, are disposed in
a relation individually corresponding to the groups of the
information transmission units 24 to 27. The information
transmission units 24 to 25 are connected to the control-
20 processing unit 22, and the information transmission
units 26 to 27 are connected to the control-processing
unit 23.

Connected also to the control-processing unit
22 are platform door control units 55 to 56 controlling
25 the opening and closure of doors disposed at the platform
of the stations in relation to the opening and closure
of the doors of the trains 53 to 54 running along the
corresponding sections of the track, a train detection

1 unit 57 detecting the position of the trains 53 to 54,
and an interlocking operation unit 58 controlling the
route of advancing movement of the trains 53 to 54 and
indicating the advancing route status. Connected also to
5 the control-processing unit 23 are platform door control
units 59 to 60 similar to the platform door control units
55 to 56, a train detection unit 61 similar to the
train detection unit 57, and an interlocking operation
unit 62 similar to interlocking operation unit 58.

10 The control-processing units 22 and 23 are
connected to each other and to an administration-processing
unit 21, which may be also composed of a computer, through
an exclusive circuit 63 which is in the form of , for
example, an optical fiber cable or a coaxial cable.
15 The administration-processing unit 21, control-processing
unit 22 and information transmission units 24 to 25
are collectively installed in a central control center.
The control-processing unit 23 and information transmission
units 26 to 27 are collectively installed in a sub-
20 control center. The central control center and sub-
control center may be located in the same place or
separate places.

 The administration-processing unit 21, which
is of the high echelon in the hierarchy arrangement,
25 exchanges information with the control-processing units
22 and 23 of the lower echelon through the exclusive
circuit 63, to carry out processing for the purpose of
administration. The administration-processing unit 21

1 supplied to the control-processing units 22 and 23 the
information including the train service schedule prepared
for the group of the trains 53 to 54, modified schedule
required to deal with, for example, a change of the trans-
5 portation demand and occurrence of an accident, and inter-
vening or interrupt information for inhibiting departure of
or emergency stopping of a train or trains. The admini-
stration-processing unit 21 functions also to monitor the
status of the train service administration and control
10 system.

The control-processing unit 22 receives train
status information from the sections 37 to 42 of the
information transmission line 36 through the trans-
mitter and receiver units 28 to 31 and information
15 transmission units 24 to 25. The control-processing
unit 22 receives also platform door status information
from the platform door control units 55 to 56, trains
position information from the train detection unit 57
and train advancing route status information from the
20 interlocking operation unit 58. In response to the
train service schedule information and interrupt information
supplied from the administration-processing unit 21, the
control-processing unit 22 generates train control command
information, platform door control command information and
25 route setting command information with appropriate timing
on the basis of the train status information, platform
door status information, train position information and
train advancing route status information applied thereto.

1 FIG. 4 is a block diagram showing the detailed
structure of the control-processing unit 22 shown in
FIG. 3. Referring to FIG. 4, the control-processing
unit 22 includes a timer 70, a plurality of memory
5 parts 71, 72, 73, 74, 75 and 76, a plurality of selector
parts 77, 78 and 79, a plurality of output parts 80, 81
and 82, and a plurality of checking parts 83, 84 and 85.

The timer 70 performs time keeping operation.
The first memory part 71 stores the train operation schedule
10 information supplied from the administration-processing
unit 21. The second memory part 72 stores the interrupt
information supplied from the administration-processing
unit 21. The third memory part 73 stores the train
position information supplied from the train detection
15 unit 57. The fourth memory part 74 stores the train
status information supplied from the information transmis-
sion units 24 to 25. The fifth memory part 75 stores
the platform door status information supplied from the
platform door control units 55 to 56. The sixth memory
20 part 76 stores the train advancing route status informa-
tion supplied from the interlocking operation unit 58.

The selector 77, 78 and 79 are actuated in
response to the application of the train position
information together with the time information and select
25 a train control command, a platform door control command
and a route setting command respectively depending on the
train service schedule. The first output part 80 supplies
the selected train control command information to the

1 information transmission units 24 to 25. The second
output part 81 supplies the selected platform door control
command information to the platform door control units
55 to 56. The third output part 82 supplies the selected
5 route setting command information to the interlocking
operation unit 58.

The first checking part 83 compares the train
control command information supplied from the first output
part 80 to the information transmission units 24 to 25,
10 with the train status information supplied to the first
memory part 74 from the information transmission units 24
to 25, and if there is a non-coincidence therebetween,
informs the administration-processing unit 21 of the
presence of non-coincidence or trouble. The second
15 checking part 84 compares the platform door control com-
mand information supplied from the second output part 81
to the platform door control units 55 to 56, with the
platform door status information supplied to the fifth
memory part 75 from the platform door control units 55
20 to 56, and, if there is a non-coincidence therebetween,
informs the administration-processing unit 21 of the
presence of non-coincidence or trouble. The third check-
ing part 85 compares the route setting command information
supplied from the third output part 82 to the interlocking
25 operation unit 58, with the train advancing route
status information supplied to the sixth memory part 76
from the interlocking operation unit 58, and, if there
is a non-coincidence therebetween, informs the administra-
tion-processing unit 21 of the presence of non-coincidence

1 or trouble.

When such a non-coincidence is found as a result of the check for comparison between the train status information and the train control command information, between
5 the platform door status information and the platform door control command information and/or between the train advancing route status information and the route setting command information, the control-processing unit 22 supplies a non-coincidence information output indicative of the presence of the non-coincidence or trouble to the administration-processing unit 21. Also the control-processing unit
10 22 supplies the train status information, platform door status information and train advancing route status information to the administration-processing unit 21.

15 The administration-processing unit 21 supplies the train service schedule information to the control-processing unit 22 and, when so required, supplies also manual interrupt information by the operator for train departure inhibition, emergency train stopping, door
20 opening-closure, etc. with appropriate timing. On the basis of the train service schedule information and interrupt information and in response to the train position information applied together with the time information as trigger the control-processing unit 22 selects and stores
25 the required train control command information, platform door control information and route setting command information in the respective selectors, and send these command information at appropriate timing. When a

1 predetermined period of time has elapsed or when any one
of the statuses changes after sending of the command
information from the control-processing unit 22, the
specific status information and command information are
5 checked to be compared with each other. When the result
of the comparison check proves that there is a non-
coincidence therebetween, the administration-processing
unit 21 at the highest echelon is informed of the presence
of non-coincidence or trouble.

10 The other control-processing unit 23 has a
structure similar to that of the control-processing unit
22 and executes functions similar to those of the control-
processing unit 22. Further, the second stage of the
track construction work can be started at any desired
15 time after the first stage of the track construction
work was completed, and it can be made while the trains
are running on the first stage track, and the second con-
trol-processing unit 23 can be very easily connected to
the administration-processing unit 21 by connecting the
20 exclusive circuit 63.

 The information transmission units 24 to 27
transmit the command information to the trains 53 to 54
through the transmitter and receiver units 28 to 35 and
the sections 37 to 48 of the information transmissition
25 line 36 according to a predetermined information
transmission sequence. Further, the information trans-
mission units 24 to 27 scan the status information of
each of the trains 53 to 54 at intervals of a

1 predetermined period of time for detecting any change in
the status of each train. When the result of scanning
proves that a change has occurred in the status of any
one of the trains, the corresponding one of the infor-
5 mation transmission units 24 to 27 transmits the
status information of the specific train to the associated
one of the control-processing units 22 and 23 at the higher
echelon.

7 The administration-processing unit 21 monitors
10 the status of the train service administration and
control system on the basis of the train status informa-
tion, platform door status information and trouble
information supplied from the control-processing units
22 and 23 and sends out interrupt information to the cont-
15 rol-processing units 22 and 23. More precisely, the
administration-processing unit 21 supplies to the
control-processing units 22 and 23 the information
including the train service schedule prepared for the
train group, modified train service schedule required
20 to deal with, for example, a change of the transporta-
tion demand and occurrence of an accident, and interrupt
information for inhibiting departure of or emergency
stopping of the train or trains, open-close control of
the platform door or doors, etc. The administration-
25 processing unit 21 functions also to offer various
information indicative of the status of the system to the
operators in the central control center, so that the
operators monitoring the status of the system on the

- 1 control panel can operate the control console as required
to supply to the control-processing units 22 and 23 the
interrupt information for inhibiting departure or
emergency stopping of a train or trains, open-close
5 control of the platform door or doors, etc.

FIG. 5 is a block diagram of another preferred
embodiment of the present invention. In FIG. 5, the
scan reference numerals are used to designate the same
or equivalent parts appearing in FIG. 3. It is to be
10 noted that, in order to provide redundancy, the admini-
stration-processing unit 21, control-processing units
22 and 23, information transmission units 24 to 27, and
transmitter and receiver units 28 to 35 shown in FIG. 3
are replaced by a dual or duplex configuration of
15 administration-processing units 21a and 21b, control
processing units 22a, 22b and 23a, 23b, information
transmission units 24a, 24b, ..., 25a, 25b and 26a,
26b, ..., 27a, 27b, and transmitter and receiver units 28a,
28b, 29a, 29b, ..., 30a, 30b, 31a, 31b and 32a, 32b,
20 33a, 33b, ..., 34a, 34b, 35a, 35b. It will be seen that
the administration-processing units 21a and 21b; control-
processing units 22a, 22b and 23a, 23b; information
transmission units 24a, 24b, ..., 25a, 25b and 26a, 26b,
..., 27a, 27b; and transmitter and receiver units 28a,
25 28b, 29a, 29b, ..., 30a, 30b, 31a, 31b and 32a, 32b,
33a, 33b, ..., 34a, 34b, 35a, 35b are provided in dual
or duplex to operate as a dual system or duplex system.
Therefore, the system constructed in this way can

1 operate with higher reliability. Although this redundant
arrangement is applied to each of the administration-
processing unit 21, control-processing units 22 and 23,
information transmission units 24 to 27 and transmitter
5 and receiver units 28 to 35 in FIG. 5, it may be applied
to at least one of them.

It will be understood from the foregoing detailed
description of the present invention that the distribution
of processing functions to the processing units arranged
10 in a hierarchy can increase the response speed for
processing. Further, because of the arrangement in which
the administration-processing unit, control-processing
unit and information transmission units are collectively
installed in the central control center to collect all
15 of the information in the central control center, the
operators in the central control center can readily
intervene in the processing by the administration-
processing unit or control-processing unit in the event
of an emergency so that unmanneding of the trains and
20 stations can be achieved. Further, the system according
to the present invention requires only a single informa-
tion requires only a single information transmission
line compared with the prior art system of the dis-
tributed control type. Therefore, the number of
25 required units can be decreased and the system construc-
tion can be simplified, thereby to make easy the main-
tenance. Furthermore, because of the fact that the
processing functions are so distributed that the

1 administration-processing unit participates in the
processing for preparation of the train service schedule
and the control-processing unit participates in the
processing for train service control, an expansion of the
5 sytem to deal with an extension of the track can be
easily done compared with that in the prior art system of
the centralized control type.

CLAIMS

1. A train service administration and control system including means for exchanging information including status information indicative of the operating status of a plurality of trains (53, ..., 54) running on the track, and command information controlling the operation of the train through an information transmission line (36) divided into a plurality of sections (37, 38, ..., 41, 42) of a predetermined length extending along the entire length of the track thereby controlling the train operation according to a train service schedule, characterized in that

a plurality of transmitter and receiver units (28, 29, ..., 30, 31) connected individually to said sections of said information transmission line, at least one information transmission unit (24, ..., 25) to be connected to at least one of said transmitter and receiver units, at least one control-processing unit (22) to be connected to said information transmission unit, and a single administration-processing unit (21) to be connected to said at least one control-processing unit, are connected to form a hierarchy structure in this order with said administration-processing unit at the top echelon.

2. A train service administration and control system as claimed in claim 1, characterized in that said administration-processing unit (21) and said control-processing unit (22) are connected to each other by an exclusive circuit (63).

3. A train service administration and control

system as claimed in claim 1 or 2, characterized in that at least one of said administration-processing unit (21), said control-processing unit (22), said information transmission unit (24, ..., 25) and the group of said plural transmitter and receive units (28, 29, ..., 30, 31) is further redundantly added to provide a multiplex system.

4. A train service administration and control system, as claimed in claim 1, 2 or 3, characterized in that,

there are further provided a plurality of information transmission line sections (43, 44, ..., 47, 48) of a predetermined length extending along an extension of said track, a plurality of transmitter and receiver units (32, 33, ..., 34, 35) connected individually to said information transmission line sections, at least one information transmission unit (26, ..., 27) to be connected to at least one of said transmitter and receiver units, and at least one control-processing unit (23) to said information transmission unit, all of said units being disposed in a hierarchy in the above order, with said control-processing unit (23) being connected to said administration-processing unit (21) of the highest order in the hierarchy arrangement.

5. A method for train service administration and control by a train service administration and control system as claimed in claim 1, 2, 3 or 4, characterized in that at least one control-processing unit (22) is connected to a single administration-processing unit

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(21), train service schedule information from said administration-processing unit is supplied to said control-processing unit, and the service of trains (53, ..., 54) existing within the governing range of said control-processing unit is controlled by the function of said control-processing unit.

FIG. 1

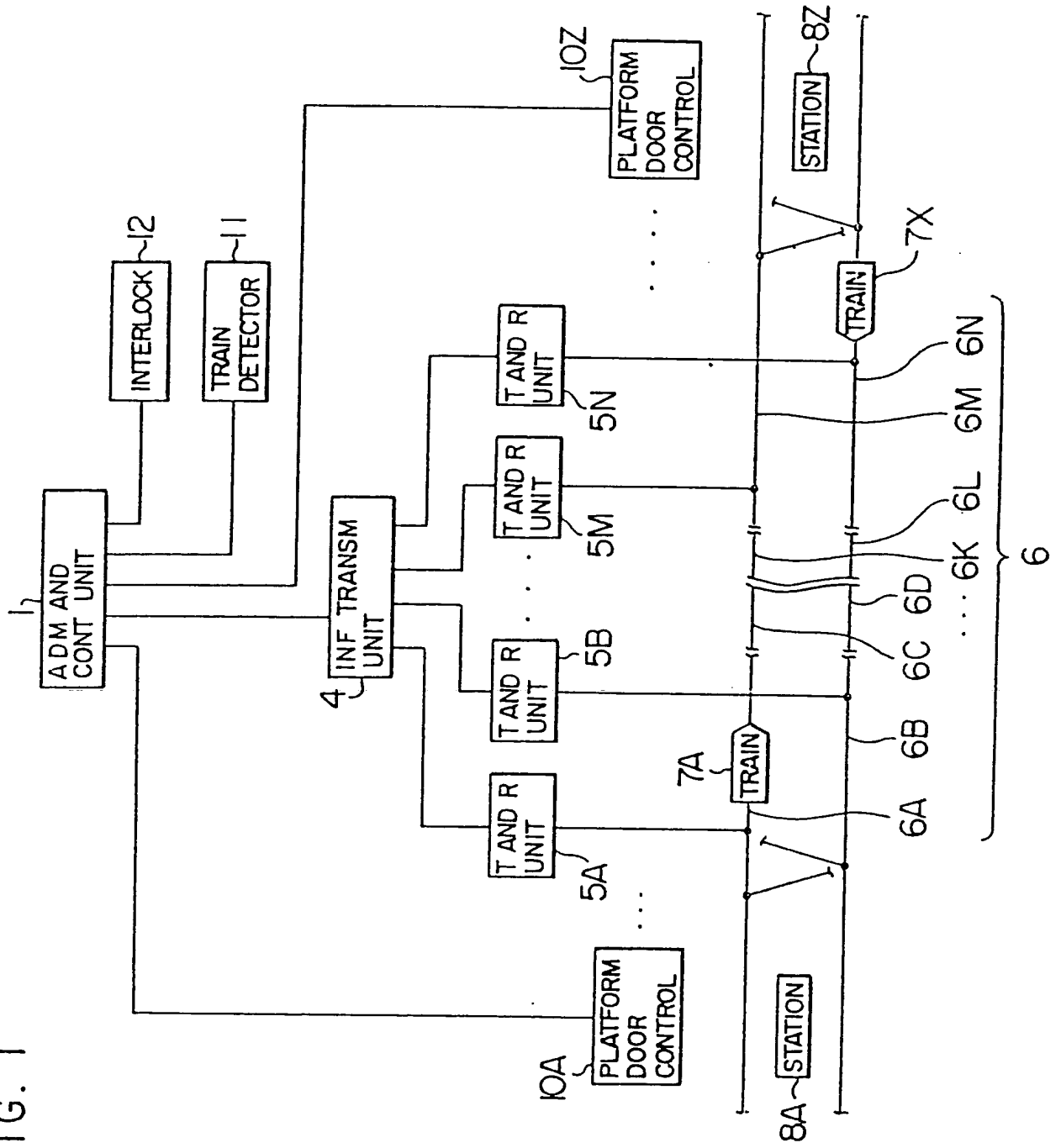


FIG. 2

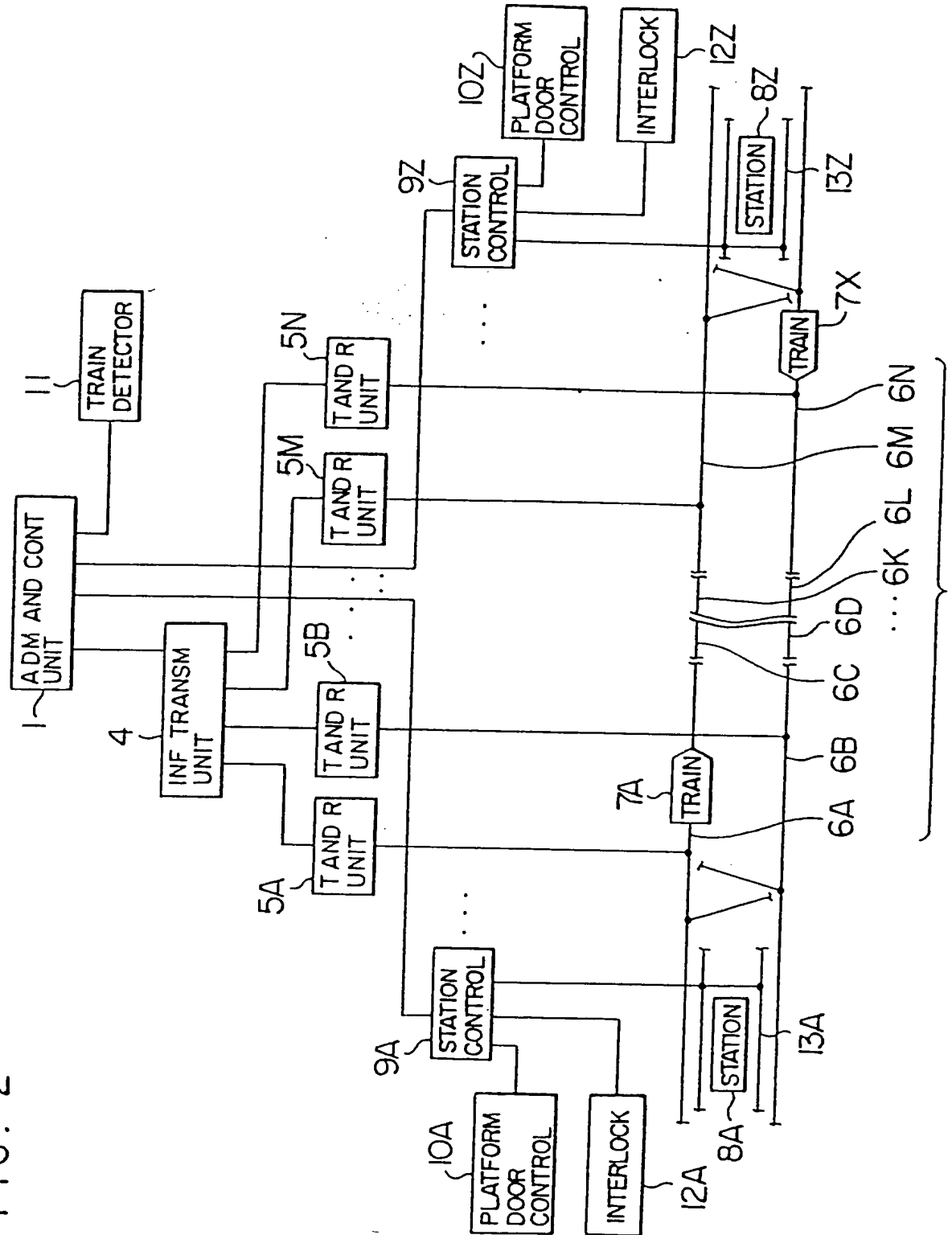


FIG. 3

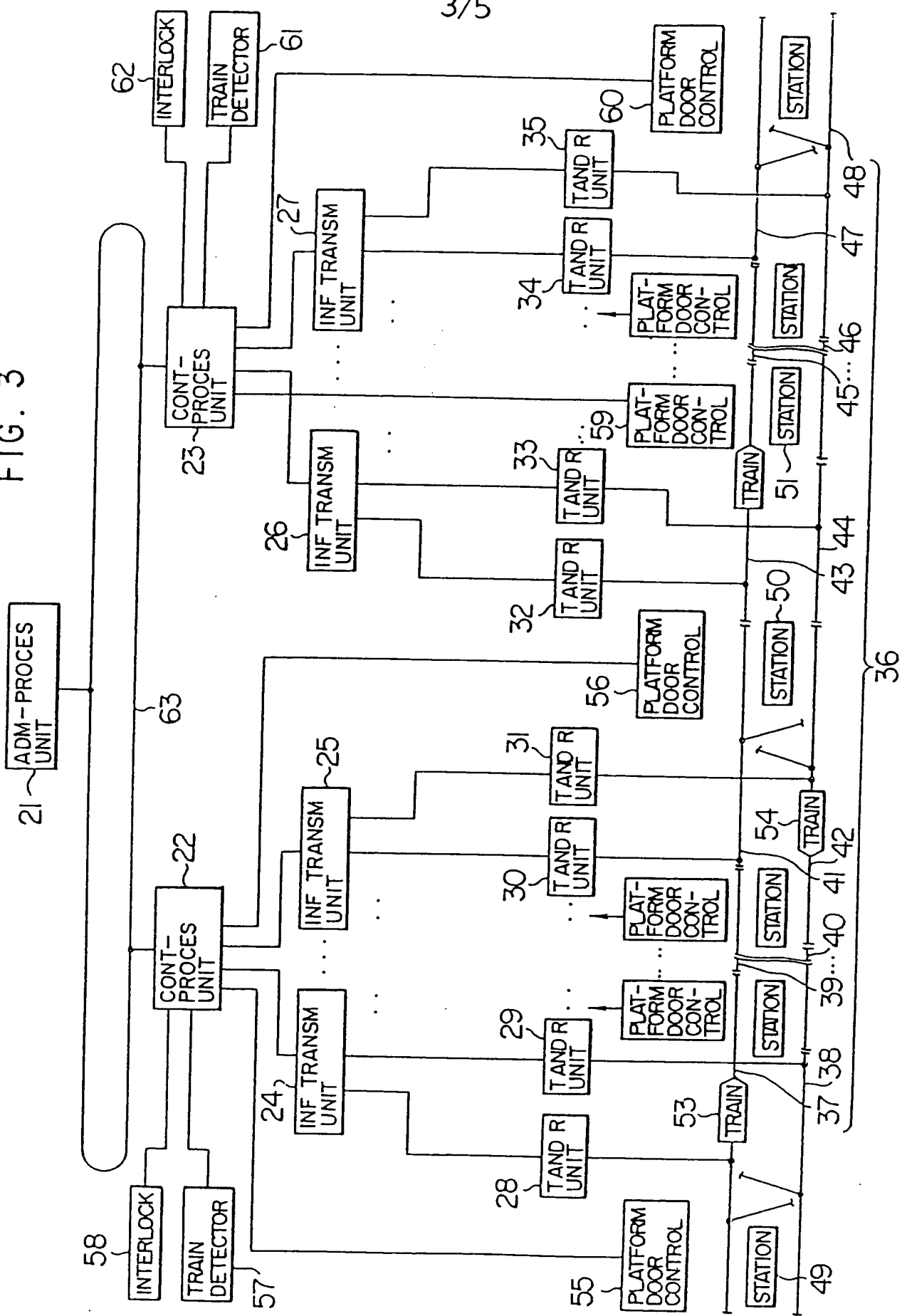


FIG. 4

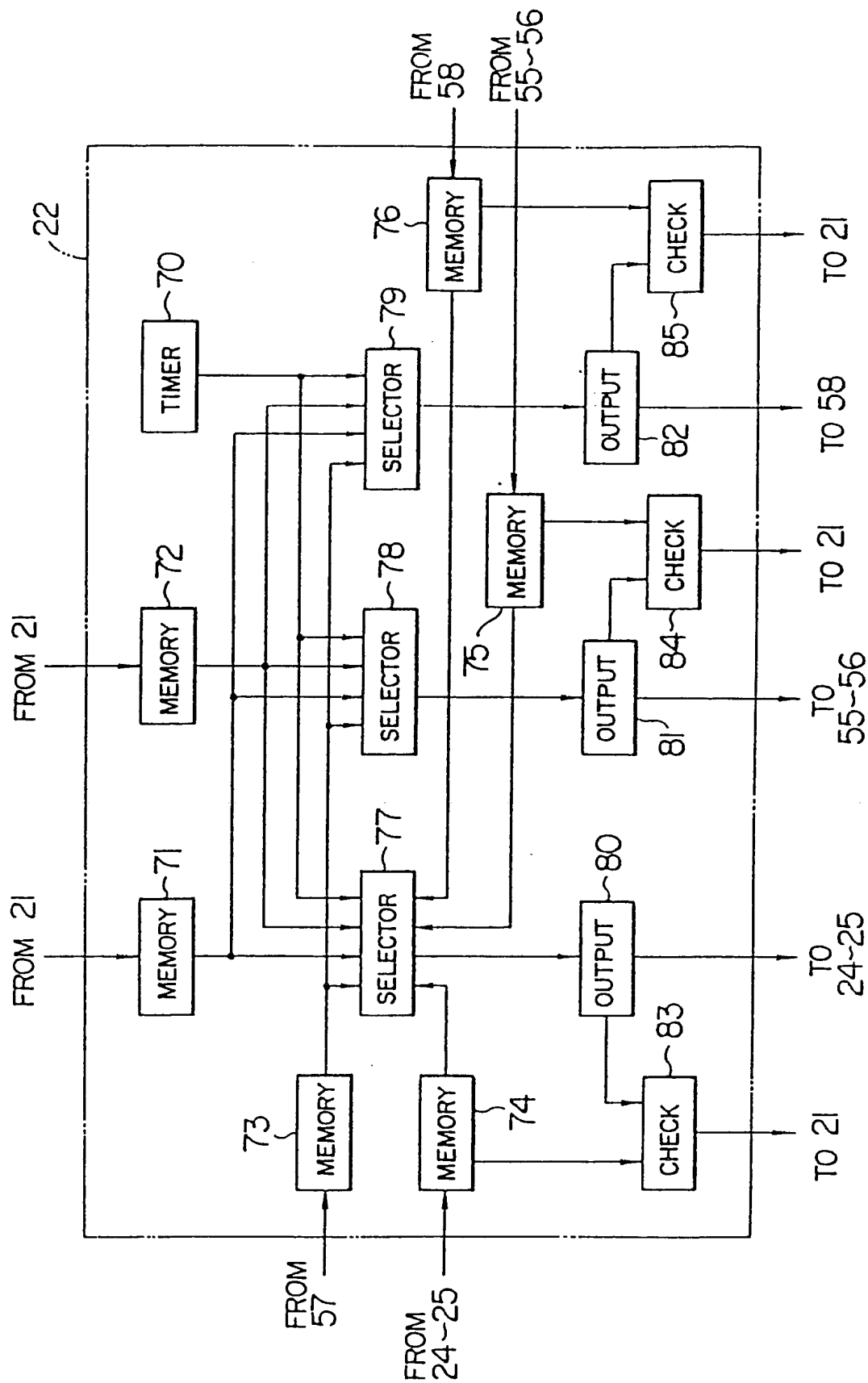
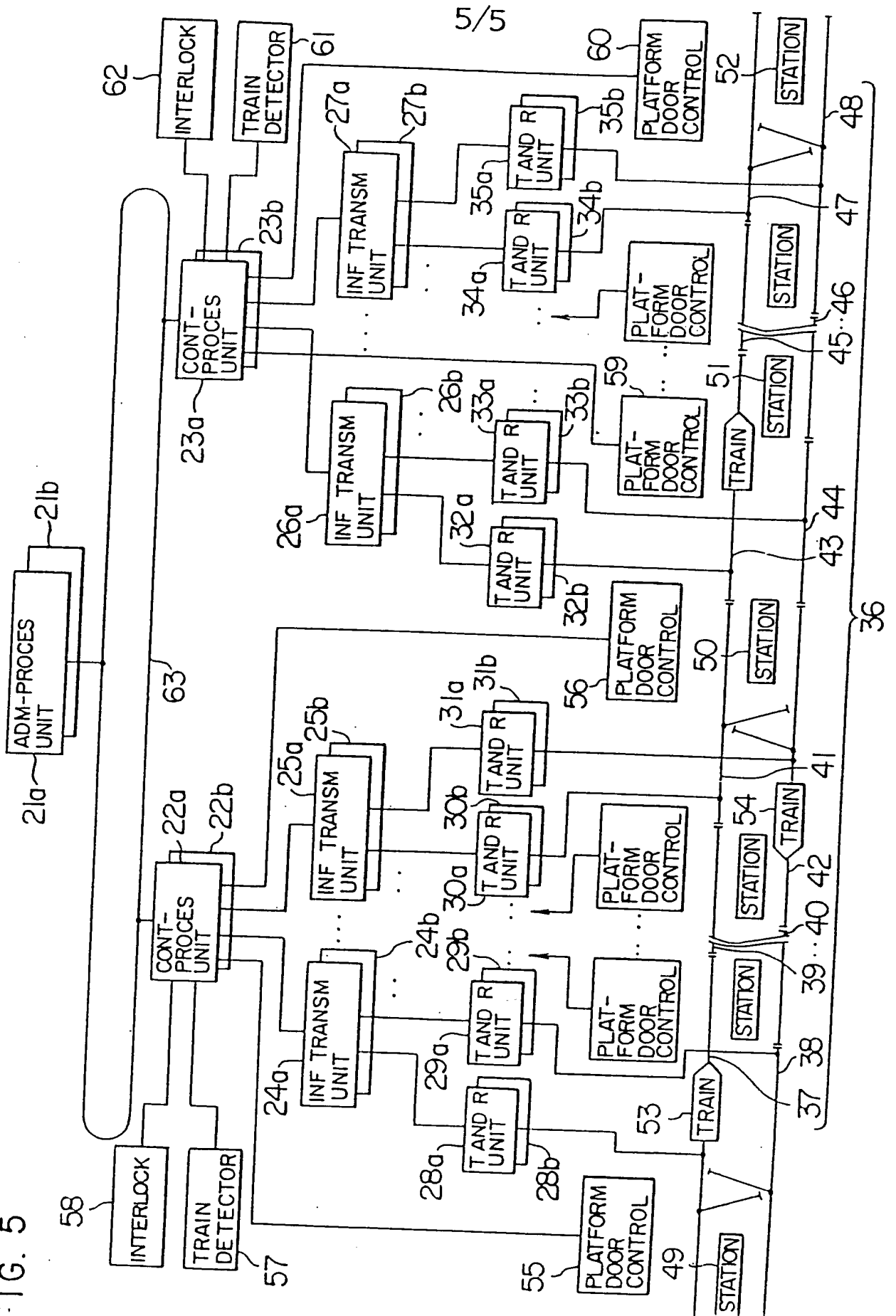


FIG. 5





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0108363
Application number

EP 83 11 0839

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
A	US-A-4 015 804 (DOBLER et al.) * Claims *	1-5	B 61 L 27/00
A	US-A-4 023 753 (DOBLER) * Claims *	1-5	
A	PATENTS ABSTRACTS OF JAPAN, vol. 1, no. 113, 29th September 1977, page 3427 M 77; & JP-A-52 49 511 (HITACHI SEISAKUSHO K.K.) 20-04-1977	1-5	
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
Place of search THE HAGUE		Date of completion of the search 25-11-1986	Examiner REEKMANS M.V.

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